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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/590,011

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Takeshi Hikata

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EXAMINER

HORNING, JOEL G

ART UNIT

PAPER NUMBER

1792

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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/590,011	Applicant(s) HIKATA, TAKESHI	
	Examiner JOEL G. HORNING	Art Unit 1792	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 23 December 2009.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1 and 3-15 is/are pending in the application.
- 4a) Of the above claim(s) 8-15 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1 and 3-7 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|----------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date <u>09-08-2009; 12-23-2009</u> . | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Election/Restrictions

1. Claims 8-15 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected invention, there being no allowable generic or linking claim. Election was made **without** traverse in the reply filed on May 29th, 2009.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. **Claims 1 and 5-7** are rejected under 35 U.S.C. 102 (b) as being anticipated by Dai et al (US 6401526).

The instant claims are directed towards a catalyst structure ***that is a columnar body with its upper surface capable of serving as a crystal growth surface***, which can be used to make carbon nanotubes by vapor deposition, which includes a catalytic material which forms a ring or a whirl on a crystal growth surface, ***and at least part of a side of said columnar body has a non-catalytic material with substantially no catalytic activity with respect to a growth of said crystalline carbon.***

Dai et al teaches a carbon nanotube catalyst structure (seen in figures 2a-d and 3), which is a columnar body with a cone shaped tip as its upper surface. The catalyst material is deposited onto part of the upper surface of this columnar body, as seen in

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figure 3, this upper surface is the crystal growth surface, with the sides of the structure being free of the catalyst and made of silicon, which is considered to have no substantial catalytic activity because a separate catalytic material is required for the catalysis of carbon nanotubes and the silicon is not recognized as a catalyst (col 6, lines 33-50). This structure is suitable for making carbon nanotubes by vapor deposition (col 6, lines 31-32). As shown in figure 2C and explained in respect to figure 1A, the center of the upper surface (the very tip of this surface) is not covered in the catalytic material, due to surface tension, so the catalyst is in the shape of a ring on the crystal growth surface (**claim 1**, col 5, lines 3-9).

3. Regarding **claim 5**, as described above, the crystal growth surface has at least two layers, a non-catalytic layer of silicon as part of the tip and a catalytic layer surrounding it.
4. Regarding **claim 6**, Dai et al teaches calcination of the iron catalyst precursor in air, forming an iron oxide catalyst (col 4, lines 39-50).
5. Regarding **claim 7**, according to dictionary.com “wavelike” is defined to mean “an outward curve, or one of a series of such curves, in a surface or line; undulation.” Thus a wavelike structure is one that has an outward curve or a series of outward curves. A cross-section of the cone shaped silicon non-catalytic tip is a circle, which includes an outward curve, so it is wavelike, meeting the claim limitations.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

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(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148

USPQ 459 (1966), that are applied for establishing a background for determining

obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
 2. Ascertaining the differences between the prior art and the claims at issue.
 3. Resolving the level of ordinary skill in the pertinent art.
 4. Considering objective evidence present in the application indicating obviousness or nonobviousness.
6. **Claims 1 and 3-5** are rejected under 35 U.S.C. 103(a) as being unpatentable over Delzeit (US 6858197).

The instant claims are directed towards a catalyst structure ***that is a columnar body with its upper surface capable of serving as a crystal growth surface***, which can be used to make carbon nanotubes by vapor deposition, which includes a catalytic material which forms a ring or a whirl on a crystal growth surface, ***and at least part of a side of said columnar body has a non-catalytic material with substantially no catalytic activity with respect to a growth of said crystalline carbon.***

Delzeit is directed towards a catalyst structure for depositing carbon nanotubes by a vapor deposition method, which includes a surface with a layer of catalyst material which is formed into a desired pattern (abstract), this pattern can be a whirl shape on a crystal growth surface (figure 2H, col 4, lines 31-42).

Delzeit further teaches that a catalyst structure having a multilayer catalyst material with a first catalytic layer of iron, cobalt, or nickel covered by a second layer of catalytic molybdenum, can then be coated with an overlayer material (which puts it on the top side of the catalyst structure) of silver (**claims 3 and 4**). This overlayer material is not taught to be catalytic and does not appear to contribute to catalysis, instead having the function of coating the outside of the grown nanotubes (col 4 line 57 through col 5, line 3). Additionally, since applicant claims that silver can be the non-catalytic material, it must have "substantially no catalytic activity with respect to a growth of said crystalline carbon." Hence the multilayer structure of the crystal growth surface is composed of catalytic and non-catalytic materials (**claim 5**).

Regarding the shape of the pattern, Delzeit further teaches that the structure can be patterned in the shape of the number "8" which is a columnar body with a ring (fig 2G, col 4, lines 23-41).

Thus it would have been obvious to a person of ordinary skill in the art at the time of invention to create the multilayer molybdenum catalyst layer with the silver non-catalytic layer on the top side of the structure in the shape of a columnar ring, since these materials are explicitly taught to be suitable for the catalyst material and the columnar ring shape is explicitly taught to be a suitable shape for the catalyst material (**claim 1**).

7. **Claim 6** is rejected under 35 U.S.C. 103(a) as being unpatentable over Delzeit (US 6858197) in view of Fan et al (Science vol 283, pages 512-514, (1999)).

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The instant claim requires that the crystal growth surface of the catalyst be oxidized.

Delzeit teaches using iron as the nanotube catalyst (abstract), but does not teach oxidizing its surface.

However, Fan et al is also directed towards patterning and vapor deposition of carbon nanotubes (abstract) by selective deposition of iron as a catalyst material, which then has its surface oxidized (page 512, col 2, lines 1-10). Fan et al further teaches that the resulting iron oxide material acts as a suitable catalyst to decompose precursor vapors so that they then form carbon nanotubes (page 513, col 1, lines 1-5).

Thus it would have been obvious to a person of ordinary skill in the art at the time of invention to substitute the iron catalyst of Delzeit with the iron oxide catalyst of Fan as a known alternative catalyst material known to be suitable for the deposition of carbon nanotubes which would produce predictable results (**claim 6**).

Response to Arguments

8. Applicant's arguments with respect to claims 1 and 3-7 have been considered but are not convincing in view of the new ground(s) of rejection necessitated by amendment.
9. Several of applicant's arguments fail to comply with 37 CFR 1.111(b) because they amount to a general allegation that the claims define a patentable invention without specifically pointing out how the language of the claims patentably distinguishes them from the references. As found on pages 5-6, applicant copies the claim

language of claim 1 and states that Delzeit does not teach all the limitations. In the rejection above, the examiner has stated the applied interpretation of the references and mapped them to the claim language. Since applicant does not point out specific supposed faults in the rejection or ways in which the amended claim language overcomes the Delzeit reference, further beneficial clarification of the examiner's position is difficult.

10. In response to applicant's argument on page 6 that the references fail to show certain features of applicant's invention, it is noted that the features upon which applicant relies (i.e., "such that the non-catalytic material prevents the crystalline carbon from being spread in direction of the crystal growth surface during crystal growth") are not recited in the rejected claim(s). Although the claims are interpreted in light of the specification, limitations from the specification are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057 (Fed. Cir. 1993). Furthermore, if applicant does amend the claim to recite this, a recitation of the intended use of the claimed invention must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim.
11. It is noted that claim 8 is not currently undergoing prosecution on the merits, being directed to a non-elected invention.
12. In response to applicant's argument on page 6 that the preferred catalyst deposition techniques are not suitable for forming columnar bodies, the examiner disagrees.

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Since these techniques are line-of-sight deposition methods, when deposited through an aperture of specified geometry, they can very easily form columnar structures with well defined topography. This is opposed to non-line-of-sight methods (like CVD) which deposit uniformly on all exposed surfaces, making columnar structures difficult to deposit (because the films are uniform), unless the aperture is a mask, physically blocking the material from depositing on certain parts of the surface or there is a subsequent etching process to define the shape.

13. In response to applicant's argument that the examiner's conclusion of obviousness is based upon improper hindsight reasoning, it must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the applicant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971). In this particular case, the secondary reference is only used to teach the suitability of using an iron oxide catalyst for carbon nanotubes. The known suitability of this catalyst was found in the prior art and not only gleaned from applicant's disclosure, so the examiner believes the reconstruction is proper. The remaining features were all found within the teaching and suggestions of the Delzeit reference.

14. The amended claim 7 has been considered and rejected with the Dai et al reference.

Conclusion

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15. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Hwang et al US 2003/0181328.

16. No current claims are allowed.

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to JOEL G. HORNING whose telephone number is (571) 270-5357. The examiner can normally be reached on M-F 9-5pm with alternating Fridays off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael B. Cleveland can be reached on (571)272-1418. The fax phone

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number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/J. G. H./
Examiner, Art Unit 1792

/Michael Cleveland/
Supervisory Patent Examiner, Art Unit 1792